



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): William S. Adney et al.

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For: Thermal Tolerant Exoglucanase
From *Acidothermus Cellulolyticus*

Group No.: 1652

Examiner: Rao, Manjunath N.

Confirmation 9964
No.

CERTIFICATE OF MAILING

I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being deposited in the United States Postal Service on the date shown below with sufficient postage for first class mail, in an envelope addressed Assistant Commissioner for Patents, Alexandria, VA 22313-1450.

May 21, 2004
Date

Brenda E. Brantley
Brenda E. Brantley

MS NON-FEE AMENDMENT

Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

Sir:

RULE 132 DECLARATION OF MICHAEL E. HIMMEL, PhD.

1. This Declaration is provided to present certain information for the Examiner's review. This information traverses nonenablement and written description rejections found in the office action dated August 7, 2003.

2. My name is Michael E. Himmel and I am named as a coinventor in this application. I am employed by the National Renewable Energy Laboratory (NREL) in Golden, Colorado. NREL which is the assignee of my invention. My job title is that of Principal Scientist, and I serve as a Focus Team Leader of NREL's Enzyme Technology team. In this context, ten professional staff and 6 university and industry subcontractors report to me.

3. Exhibit A attached to this Declaration is my brief curriculum vitae summarizing my educational background and work experience.
4. Exhibit B attached to this Declaration is a list of publications and presentations where I am an author, coauthor, or coinventor.
5. I have reviewed the present claims and the office action dated August 7, 2003.
6. Exhibit C attached to this Declaration is a printout obtained from the Internet on October 27, 2003 from the CAZy database, which is a free search engine capable of accessing a database that compiles sequences for hydrolyzing enzymes and associated binding molecules. Exhibit C provides contact and citation information identifying the CAZy database, which has been active since at least 1999.
7. Exhibit D attached to this Declaration is a CAZy printout summarizing known GH48 family glycoside hydrolases. A total of sixteen such domains are published in CAZy with reference to the source articles and cross-references to other computer-searchable databases that contain similar information including GenBank/GenPept (21 GH48 domains), and Swissprot (10 GH48 domains).
8. Exhibit E to this Declaration is a CAZy printout summarizing known CBDII domains. A total of one-hundred twenty-five such domains are published in CAZy with reference to the source articles and cross-references to other computer-searchable databases that contain similar information including GenBank/GenPept (179 CBDII domains), and Swissprot (83 CBDII domains).
9. Exhibit F to this Declaration is a CAZy printout summarizing known CBDIII domains. A total of sixty-six such domains are published in CAZy with

reference to the source articles and cross-references to other computer-searchable databases that contain similar information including GenBank/GenPept (77 CBDIII domains), and Swissprot (45 CBDIII domains).

10. Classification of GH48, CBDII and CBDIII domain families for use in database retrieval is routine in the art, for example, as described in the Henrissat article (1999) cited in Exhibit C.

11. Applying just the CAZy results alone, there appear to be at least 132,000 combinations of known family domains GH48, CBDII, and CBDIII. This calculation is made as $66 \times 125 \times 77 = 132,000$.

12. Databases including CAZy, Swissprot, Genbank, PDB, 3D and others contain domain information organized into family groups including GH48, CBDII and CBDIII. These databases constitute fundamental tools that at time are essential for research, and substantially all researchers in this field of endeavor are aware of and use such databases. It is a trivial matter to consult these databases and ascertain family domain information.

13. Regardless of how the family information is obtained, knowledge of domain families is an essential tool of hydrolyzing enzyme research. The Specification sufficiently communicate to those skilled in the art that GH48 family, CBDII family and CBDIII family domains are germane to the disclosure. The Specification cites various articles that pertain to the classification of domains in these families, for example, in the paragraphs beginning at line 6 on page 15 and line 4 on page 17 of the Specification.

14. Exhibits C, D, E, and F are provided to show, in context of the patent disclosure, that domain families are well known as isolated elements. The specification

sufficiently conveys a knowledge of how to combine these isolated elements in the form that is now specifically claimed. We believe that the GuxI peptide is novel, but also that the combination of known GH48, CBDII and CBDIII domains is also novel as a combination that can straightforwardly be constructed as taught by the Specification.

15. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: 5/19/04

By: Michael E. Himmel

Michael E. Himmel, PhD



MICHAEL E. HIMMEL

OBJECTIVES

Engineering improved industrial biocatalysts for biomass conversion using a knowledge-based approach to enzyme and cell function.

WORK EXPERIENCE

1998-present National Renewable Energy Laboratory Golden, CO

Principal Scientist

- Focus Team Leader – Enzyme Technology team (10 professional staff and 6 university and industry subcontractors).

1985 - 1999 National Renewable Energy Laboratory Golden, CO

Senior Scientist II

Team Leader – Enzyme Technology team (manage 7 scientists doing the biochemistry and cloning/expression of selected glycosyl hydrolases).

1980 - 1985 Solar Energy Research Institute Golden, CO

Senior Scientist I – Staff Microbiologist

Biochemist working on the isolation and characterization of new microorganisms and enzymes from extreme natural environments.

EDUCATION

1974 - 1980 Colorado State University Fort Collins, CO

PhD/Biochemistry

1970 - 1974 University of Northern Colorado Greeley, CO

BS/Chemistry with Biology Minor (Magna Cum Laude)

PATENTS AND PUBLICATIONS

Full length scientific papers, posters, presentations, patents ~ 300

AWARDS RECEIVED

1990 – American Chemical Society Outstanding Service Award

1992 – NREL/MRI Staff Award for Outstanding Performance

1998 – NREL/MRI Staff Award for Outstanding Team Performance

2002 – NREL/MRI H. Hubbard Award for Research Management

CIRICULUM VITAE - BRIEF

Michael E. Himmel, PhD

EDUCATION

PhD 1980 Biochemistry, Colorado State University, Fort Collins, CO.

BS 1974 Chemistry Major, University of Northern Colorado, Greeley, CO.

QUALIFICATIONS AND EXPERIENCE

Dr. Himmel has 26 years of progressive experience in conducting, supervising, and planning research in protein biochemistry, recombinant technology, enzyme engineering, new microorganism discovery, and the physicochemistry of macromolecules. Although known internationally for his work in cellulase biochemistry and lignin characterization, he has directly supervised projects that target the isolation of new, thermotolerant microorganisms; as well as the cloning and application of the thermal stable enzymes they produce. He has also supervised research that targets the application of site-directed-mutagenesis and rational protein design to the stabilization of important industrial enzymes. As might be expected, the development of new assays for hydrolytic enzymes is an important aspect of such enzyme engineering work, and he has contributed many new methods to the literature. Dr. Himmel also initiated and managed the first Chemical Analysis and Testing team in the DOE OTT Biofuels program at NREL. This team conducted advanced chemical analyses and quality control operations for a Division of 100 staff. Dr. Himmel's work history also encompasses pilot plant scale experience, as he designed various facilities and novel equipment for process biotechnology research, including a series of novel high solids fermenters for methane production, a paddle type reaction/fermentation system for high solids processes, and several pilot plant scale, preparative chromatography systems. More recently, Dr. Himmel was co-investigator on a successful proposal funded by DOE OS Nanotechnology that will explore the application of novel protein scaffolds to create self-assembling arrays of quantum dots.

Dr. Himmel currently manages the DOE OTT Biofuels Enzyme Technology team of 10 staff scientists and directly monitors 5 DOE/NREL subcontracts at universities and biotechnology companies. In 1998, the Enzyme Technology team received the NREL Research Team Award. The daily interaction with junior and senior engineers, program managers and planners, and NREL support staff has always been an important element of his job description. Apart from this, Dr. Himmel serves as adjunct faculty to the Agricultural and Chemical Engineering Department at Colorado State University. In this role, he has served on five doctoral committees. Dr. Himmel has organized 4 international American Chemical Society symposia, each resulting in ACS books (i.e., Vols. 460, 516, 586, 769) edited by Dr. Himmel. During the last decade, Dr. Himmel has contributed over 290 journal papers and meeting abstracts, as well as 16 NREL/DOE patents and patent applications. Dr. Himmel is currently Chairman of the new Gordon Research Conference on "Cellulases and Cellulosomes."

MICHAEL EDWARD HIMMEL

PUBLICATION LIST

JOURNAL AND SYMPOSIUM PAPERS

1. "Arginine Deiminase from *Mycoplasma arthritidis*: Properties of the Enzyme from Log Phase Cultures", J.L. Weickmann, M.E. Himmel, P.G. Squire and D.E. Fahrney, J. Biol. Chem., **253**, 6010-6015 (1978).
2. "Isolation and Physical Characterization of Bovine Lens Crystallins", S-H. Chiou, P. Azari, M.E. Himmel and P.G. Squire, Int. J. Pept. Protein Res., **13**, 409-417 (1978).
3. "Arginine Deiminase: Demonstration of Two Active Sites and Possible Half-of-the-Sites Reactivity", J.L. Weickmann, M.E. Himmel, D.W. Smith and D.E. Fahrney, Biochem. Biophys. Res. Commun., **83**, 107-113 (1978).
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5. "Hydrodynamics and Protein Hydration", P.G. Squire and M.E. Himmel, Arch. Biochem. Biophys., **196**, 165-177 (1979).
6. "Physical-Chemical Studies of Bacterial Macromolecules and Model Systems", M.E. Himmel, Ph.D. Thesis, Colorado State University, Fort Collins, CO, 1980.
7. "High Pressure Gel Permeation Chromatography of Native Proteins on TSK-SW Columns", M.E. Himmel and P.G. Squire, Int. J. Pept. Protein Res., **17**, 365-373 (1981).
8. "High Pressure Size Exclusion Chromatography of Sea Worm Chlorocruorin and Other Large Proteins, Viruses and Polysaccharides on a TSK G5000 PW Preparative Column", M.E. Himmel and P.G. Squire, J. Chromatogr., **210**, 443-452 (1981).
9. "A Novel Dialysis Fermenter Design and its Application to the Growth of *Pasteurella haemolytica*", M.E. Himmel, P. Walker, L.H. Lauerman and P.G. Squire, Biotechnol. Lett., **4** (2), 97-102 (1982).
10. "A Rapid Method for Purification of Plasmid DNA and DNA fragments from DNA Linkers Using High Performance Liquid Chromatography on TSK-PW Gel", M.E. Himmel, P.J. Perna and M.W. McDonell, J. Chromatogr., **240**(1), 155-163 (1982).
11. "Size Exclusion at the External Surfaces of Spherical Packings used in HPLC", P.G. Squire, A. Magnus and M.E. Himmel, J. Chromatogr., **242**(2), 255-266 (1982).
12. "Purification and Partial Characterization of a Macrophage Cytotoxin from *Pasteurella haemolytica*", M.E. Himmel, M.D. Yates, L.H. Lauerman and P.G. Squire, Am. J. Vet. Res., **43**(5), 764-767 (1982).
13. "Analysis of Oligomeric Fermentation Substrates and Products by High Pressure Size Exclusion Chromatography", K.K. Oh, J. Janssens, K. Grohmann and M.E. Himmel, Biotechnol. Lett., **4**(7) (1982).
14. "A Novel Reaction Bomb Sampling Device for Microparticulate Slurries", M.E. Himmel, K.K. Oh, M. Tucker, and J. Janssens, Biotechnol. Bioeng., **25**, 619-622 (1983).
15. "High Performance Size Exclusion Chromatography of Low-Molecular Weight Lignins and Model Compounds", M.E. Himmel, K.K. Oh, D.W. Sopher and H.L. Chum, J. Chromatogr., **267**(2), 249-265 (1983).
16. "Applications of High Performance Size Exclusion Chromatography in Biomass Processing", M.E. Himmel and K.K. Oh, Biotechnol. Bioeng. Symp., **13**, 583-595 (1983).
17. "Isolation and Characterization of a Glucoamylase from *Saccharomyces diastaticus*", M. Tucker, M. Himmel and K. Grohmann, Biotechnol. Bioeng. Symp., **14**, 279-293 (1985).

18. "Chemical-Mechanical Treatments for the Enhanced Utilization of Straw", K. Grohmann, M. Himmel, R. Torget, C. Rivard, J. Baker and M. Graboski, Biotechnol. Bioeng. Symp., **14**, 137-157 (1985).
19. "Comminution of Biomass: Knife and Hammer Mills", M. E. Himmel, M. Tucker, J. Baker, C. Rivard, K.K. Oh and K. Grohmann, Biotechnol. Bioeng. Symp., **15**, 39-58 (1985).
20. "Utilization of Hydrolysate from Acidic Pretreatment of Biomass in a Mesophilic Fermentation System for the Production of Methane: Comparison of the Standard CSTR with Up-Flow Packed Bed Reactors", C. Rivard, M.E. Himmel and K. Grohmann, Biotechnol. Bioeng. Symp., **15**, 375-385 (1985).
21. "Optimization of Dilute Acid Pretreatment of Biomass", K. Grohmann, R. Torget and M.E. Himmel, Biotechnol. Bioeng. Symp., **15**, 59-80 (1985).
22. "Anaerobic Digestion of Hemicellulosic Feedstocks", C. Rivard, M. Himmel and K. Grohmann, Proceedings of the First Symposium on Biotechnological Advances in Processing Municipal Wastes for Fuels and Chemicals, Argonne National Labs, ANL/CNSV-TM-167, pp. 261-282 (1985).
23. "Noble, Diatomic and Aliphatic Gas Analysis by Aqueous HPLC", J.O. Baker, M.P. Tucker and M.E. Himmel, J. Chromatogr., **346**, 93-109 (1985).
24. "Separation of Sugar Anomers by Aqueous Chromatography on Calcium- and Lead-Form Ion Exchange Columns: Application to Anomeric Analysis of Enzyme Reaction Products", J.O. Baker and M.E. Himmel, J. Chromatogr., **357**, 161-181 (1986).
25. "A Novel Acid Addition System for the Low Pressure Reaction Bomb", M. Himmel, Biotechnol. Bioeng., **28**(1), 126-128 (1986).
26. "Isolation and Characterization of a 1,4- β -D-Glucan Glucohydrolase from the Yeast, *Torulopsis wickerhamii*", M.E. Himmel, M.P. Tucker, K.K. Oh, S. Lastick, J. Fox, D. Spindler and K. Grohmann, J. Biol. Chem., **261**(28), 12948-12955 (1986).
27. "Isolation and Characterization of a New Genus of Thermophilic, Acidophilic, Cellulolytic Bacteria, *Acidothermus cellulolyticus*, gen. nov., sp. nov.", A. Mohagheghi, K. Grohmann, M. Himmel, L. Leighton and D. Updegraff, Int. J. Systematic Bacteriology, **36**(3), 435-443 (1986).
28. "Evaluation of Spray Drying Methods for Cellulase Preservation", M. Himmel, M. Tucker, K.K. Oh, C. Rivard and K. Grohmann, Biotechnol. Bioeng. Symp., **17**, 413-423 (1986).
29. "Dilute Acid Pretreatment of Biomass at High Solids Concentrations", K. Grohmann, R. Torget and M. Himmel, Biotechnol. Bioeng. Symp., **17**, 135-151 (1986).
30. "Some Aspects of Lignin Characterization of HPSEC Using Styrene-Divinylbenzene Copolymer Gels", H.L. Chum, D.K. Johnson, M.P. Tucker and M.E. Himmel, Holzforschung, **41**, 97-108 (1987).
31. "Correlations Between Differential Scanning Microcalorimetry (DSC) and Classical Enzyme Temperature-Activity Profiles", J.O. Baker, M.P. Tucker, K. Tatsumoto, K.K. Oh, K. Grohmann, and M.E. Himmel, J. Cellular Biochem. Suppl. **11C**, 212 (1987).
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34. "Digestion of Pretreated Aspen Substrates: Hydrolysis Rates and Adsorptive Loss of Cellulase Enzymes", K. Tatsumoto, J.O. Baker, M.P. Tucker, K.K. Oh, A. Mohagheghi, K. Grohmann and M. E. Himmel, Appl. Biochem. Biotechnol., **18**, 159-174 (1988).

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36. "Properties of Genetically Overproduced *E. coli* Xylose Isomerase", M.Y. Tucker, M.P. Tucker, M.E. Himmel, K. Grohmann, and S.M. Lastick, Biotech. Lett., **10**(2), 79-84 (1988).
37. "Thermal Stabilization of Fungal β -glucosidase through Glutaraldehyde Crosslinking", J.O. Baker, K.K. Oh, K. Grohmann, and M.E. Himmel, Biotech. Lett., **10**(5), 325-330 (1988).
38. "Physicochemical Characterization of γ -Crystallins from Bovine Lens - Hydrodynamic and Biochemical Properties", S.-H. Chiou, P. Azari, and M.E. Himmel, J. Protein Chem., **7**(1), 67-80 (1988).
39. "Enhanced Stability of Glucoamylase through Chemical Crosslinking", K. Tatsumoto, J.O. Baker, K.K. Oh, and M.E. Himmel, Appl. Biochem. Biotechnol., **20/21**, 293-308 (1989).
40. "The Role of Ester Groups in Resistance of Plant Cell Wall Polysaccharides to Enzyme Hydrolysis", K. Grohmann, M.E. Himmel, and D. Mitchell, B. Dale, and H. Schroeder, Appl. Biochem. Biotechnol., **20/21**, 45-61 (1989).
41. "Anaerobic High Solids Fermentation of Processed Municipal Solid Wastes for the Production of Methane", C.J. Rivard, M.E. Himmel, T.B. Vinzant, W.S. Adney, C.E. Wyman, and K. Grohmann, Appl. Biochem. Biotechnol., **20/21**, 461-478 (1989).
42. "Ultra-Thermostable Cellulases from *Acidothermus cellulolyticus*: Comparison with Previously Reported Cellulases", M.P. Tucker, A. Mohagheghi, K. Grohmann and M.E. Himmel, Bio/Technology, **7**(8), 817-820 (1989).
43. "Detection of Extra-Cellular Hydrolytic Enzymes in the Anaerobic Digestion of Municipal Solid Waste", W.S. Adney, C.J. Rivard, K. Grohmann, and M.E. Himmel, Biotechnol. Appl. Biochem., **11**, 387-400 (1989).
44. M.E. Himmel, K. Tatsumoto, K.K. Oh, K. Grohmann, and D.K. Johnson, and H.L. Chum, "Molecular Weight Distribution of Aspen Lignins from Universal Calibration", In *Lignin: Properties and Materials*, (W. Glasser and S. Sarkanen, eds.), ACS Book Series **397**, American Chemical Society: Washington, DC, 1989; pp 82-99.
45. "Alkaline SEC of Lignins and Coal Extracts using Cross-Linked Dextran Gels", M.E. Himmel, K.K. Oh, D.R. Quigley, and K. Grohmann, J. Chromatogr., **467**(1), 309-314 (1989).
46. "Physicochemical Characterization of γ -Crystallins from Bovine Lenses: Hydrodynamic and Aggregation Properties", S.-H. Chiou, P. Azari, M.E. Himmel, H.-K. Lin, and W.-P. Chang, J. Protein Chem., **8**(1), 19-32, (1989).
47. "Purification of Lipopolysaccharide and Capsular Polysaccharide Antigenic Fractions of *Pasteurella haemolytica* using Hydrophobic Interaction Chromatography", M.E. Himmel, T.Y. Byrne, J. Johnson, and P.G. Squire, Amer. J. Vet. Res., (In preparation).
48. "Effect of the Degree of Acetylation on the Enzymatic Digestion of Acetylated Xylans", D.J. Mitchell, K. Grohmann, M.E. Himmel, and B.E. Dale and H.A. Schroeder, J. Wood Chemistry and Technology, **10**(1), 111-121, (1990).
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53. "Dilute Acid Pretreatment of Short Rotation Woody and Herbaceous Crops", R. Torget, P. Werdene, M. Himmel, and K. Grohmann, Appl. Biochem. Biotechnol., **24/25**, 115-126 (1990).
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55. "Cellulase Production by *Acidothermus cellulolyticus*", J. Linden, M. Shiang, A. Mohagheghi, C. Rivard, K. Grohmann, and M.E. Himmel, Appl. Biochem. Biotechnol., **24/25**, 223-235 (1990).
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58. "Cross-Reactive and Specific Monoclonal Antibodies Against Cellobiohydrolase I, Cellobiohydrolase II, Endoglucanase I, and Endoglucanase II of *Trichoderma reesei*", R.A. Nieves, M.E. Himmel, R.J. Todd, and R.P. Ellis, Appl. Environ. Microbiol., **56(4)**, 1103-1108 (1990).
59. Interactions of Pretreated Substrates with Cellulase Systems from *Trichoderma reesei* and Anaerobic Bacteria", K. Grohmann, C.J. Rivard, W.S. Adney, T.B. Vinzant, D.J. Mitchell, and M.E. Himmel, In *Trichoderma reesei Cellulases: Biochemistry, Genetics, Physiology and Applications*, (C.P. Kubicek, D.E. Eveleigh, H. Esterbauer, W. Steiner, E.M. Kubicek-Pranz, eds.), Royal Society of Chemistry: Graz, Austria, 1990; pp 185-199.
60. "Anaerobic Digestion of Processed Municipal Solid Waste Using a Novel High Solids Reactor: Maximum Solids Levels and Mixing Requirements", C.J. Rivard, M.E. Himmel, T.B. Vinzant, W.S. Adney, C.E. Wyman, and K. Grohmann, Biotechnol. Lett., **12(3)**, 235-240 (1990).
61. "Evaluation of Alkaline-Earth and Transition Metals for Use in Ion-Moderated Partition Chromatography of Sugars", G.R. Noll, N. Nagle, J.O. Baker, D.J. Mitchell, K. Grohmann, and M.E. Himmel, J. Liq. Chromatogr., **13(4)**, 703-714 (1990).
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63. "Enhanced Production of Cellulase by *Acidothermus cellulolyticus* in Fed-Batch Culture", M. Shiang, J.C. Linden, A. Mohagheghi, K. Grohmann, and M.E. Himmel, Appl. Microbiol. Biotechnol., **34**, 591-597 (1991).
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VIDEO/ANIMATION

1. "Cellulase Animation," M. Himmel, S. Decker, W. Adney, J. Baker, Run time 11 min., NREL, Golden, CO. 2000. Copyright DOE/MRI PAU2-568-354.
2. "Cellulase Animation - Brief," Michael Himmel and Dan Seely, Run time 6 min., NREL, Golden, CO. 2000. Copyright DOE/MRI.
3. "Simultaneous Saccharification Fermentation Animation," Michael Himmel and Dan Seely, Run time 15 min., NREL, Golden, CO. In preparation

MEETING ABSTRACTS AND PROCEEDINGS

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25. "Characterization of the Highly Thermal-Stable Cellulase System from *Acidothermus cellulolyticus*", M. Tucker, K.K. Oh, C. Rivard, A. Mohagheghi, K. Grohmann and M. Himmel, 1987 Annual Meeting of the ACS, Cellulose, Paper and Textile Division (Enzymatic Hydrolysis of Cellulose), Paper No. 43, Denver, CO, April (1987).
26. "Correlations Between Differential Scanning Microcalorimetry (DSC) and Enzyme Classical Temperature-Activity Profiles", J.O. Baker, M.P. Tucker, K. Tatsumoto, K.K. Oh, K. Grohmann and M. Himmel, DuPont-UCLA Symposium Series: Protein Structure and Design, Poster N201, Steamboat Springs, CO, April (1987).
27. "Isolation and Characterization of a Novel Sporulating Strain of Methanogen Isolated from Yellowstone National Park", C.J. Rivard, P.C. Maness, M.P. Tucker, K. Grohmann and M.E. Himmel, The 1987 Annual Meeting for the American Society for Microbiology, Poster 178, Atlanta, GA, (1987).
28. "Fungal Cellulase Utilization with Pretreated Aspen Substrates", M.E. Himmel, J.O. Baker, K. Tatsumoto, M.P. Tucker, and K. Grohmann, The 9th Symposium on Biotechnology for Fuels and Chemicals, Poster 89, Boulder, CO, May (1987).
29. "Initial Design and Evaluation of a Dilute Acid Pretreatment Process for Aspen Wood Chips", R. Torget, M. Himmel, J. Wright, and K. Grohmann, The 9th Symposium on Biotechnology for Fuels and Chemicals, Poster 44, Boulder, CO, May (1987).
30. "Alkaline Delignification of Biomass Pretreated with Dilute Acid", R. Torget, K. Grohmann, and M.E. Himmel, Poster 45, The 9th Symposium on Biotechnology for Fuels and Chemicals, Boulder, CO, May (1987).
31. "Molecular Weight Distribution of Hardwood Lignins: A Hydrodynamic Approach", K. Tatsumoto, K.K. Oh, K. Grohmann, H. Chum, D.K. Johnson, and M.E. Himmel, 195th ACS Meeting, Paper & Textile and Polymer Division, Toronto, Canada, June (1988).
32. "Effects of Sequential Acidic and Alkaline Pretreatment on Enzymatic Digestibility of Cellulose in Aspen Wood and Wheat Straw", K. Grohmann, R. Torget, and M. Himmel, IEA/Bioenergy Agreement, Bioconversion of Lignocellulosics, Toronto, Canada, June (1988).
33. "Thermostable Cellulases Produced by a Novel Bacterium from Geothermal Hot Springs", K. Grohmann, M.P. Tucker, A. Mohagheghi, and M.E. Himmel, The 8th International Biotechnology Symposium, Paris, July 1988.
34. "High Temperature Enzymes from *Acidothermus cellulolyticus* for Food Applications", M. Tucker, A. Mohagheghi, K. Grohmann, and M.E. Himmel, poster for Colorado Technology Transfer Meeting, Westminster, CO, July 1988.
35. "Dilute Sulfuric Acid Pretreatment of Hardwood Bark", R. Torget, M.E. Himmel, and K. Grohmann, The Tenth Symposium on Biotechnology for Fuels and Chemicals, Poster No. 39, Gatlinburg, TN, May (1988).
36. "Application of Chemical Crosslinking to *Aspergillus niger* Glucoamylase", K. Tatsumoto, J.O. Baker, K.K. Oh, and M.E. Himmel, The Tenth Symposium on Biotechnology for Fuels and Chemicals, Poster No. 58, Gatlinburg, TN, May (1988).
37. "The Role of Ester Groups in Resistance of Plant Cell Wall Polysaccharides to Enzyme Hydrolysis", K. Grohmann, M.E. Himmel, and D. Mitchell, B. Dale, and H. Schroeder, The Tenth Symposium on Biotechnology for Fuels and Chemicals, Paper No. 04, Gatlinburg, TN, May (1988).
38. "Anaerobic High Solids Fermentation of Processed Municipal Solid Wastes for the Production of Methane", C.J. Rivard, M.E. Himmel, T.B. Vinzant, W.S. Adney, C.E. Wyman, and K. Grohmann, The Tenth Symposium on Biotechnology for Fuels and Chemicals, Poster No. 66, Gatlinburg, TN, May (1988).
39. "Detection of Extracellular Hydrolytic Enzymes in Anaerobic Digestion of Municipal Solid Wastes", W.S. Adney, C.J. Rivard, K. Grohmann and M.E. Himmel, The 1988 ASM Annual Meeting, Poster O53, Miami Beach, FL, May (1988).
40. "Production of Enzyme Specific and Enzyme Cross-reactive Monoclonal Antibodies for *T. reesei* Cellulases", R. Nieves, M.E. Himmel, and R.P.

Ellis, The 1988 ASM Annual Meeting, Poster O17, Miami Beach, FL, May (1988).

41. "SERI Collection Efforts in Yellowstone National Park", W.S. Adney, C.J. Rivard, K. Grohmann, and M.E. Himmel, Rocky Mountain Branch of the American Society for Microbiology, Pingree Park, CO, October (1988).
42. "Thermostable Enzymes From Thermophiles and Chemical Crosslinking", M.E. Himmel, J.O. Baker, M.P. Tucker, C.J. Rivard, K. Tatsumoto, A. Mohagheghi, K.K. Oh, and K. Grohmann, Colorado Biotechnology Symposium, Hosted by the Colorado Institute for Research in Biotechnology, Colorado State University, Fort Collins, CO, September (1988).
43. "Production of Enzyme-Specific and Enzyme-Cross-Reactive Monoclonal Antibodies for *Trichoderma reesei* cellulases", R.A. Nieves, R.P. Ellis, and M.E. Himmel, Colorado Biotechnology Symposium, Hosted by the Colorado Institute for Research in Biotechnology, Colorado State University, Fort Collins, CO, September (1988).
44. "Garbage to Methane: Models and Implementation", T.B. Vinzant, C.J. Rivard, W.S. Adney, M.E. Himmel, and K. Grohmann, Presented at the Annual Rocky Mountain Regional Meeting of the ASM, Fort Collins, CO, April (1989).
45. "Production of Monoclonal Antibodies Specific for Endoglucanase I and Cellobiohydrolase II of *Trichoderma reesei*", R.A. Nieves, R.P. Ellis, and M.E. Himmel, Annual Rocky Mountain Regional Meeting of the ASM, Poster 06S, Fort Collins, CO, April (1989).
46. "Molecular Weight Distribution of Aspen Lignins: Application of Kirkwood-Riseman Theory", K. Tatsumoto, K. Grohmann, H. Chum, and M.E. Himmel, Presented at the 1989 ACS Pre-Symposium Workshop, Modern Methods of Wood and Plant Analysis, Myrtle Beach, South Carolina, May (1989).
47. "High Solids Anaerobic Digestion of MSW for the Production of Methane: Successful Operation of a Novel Laboratory-Scale, Continuously Mixed Reactor", C.J. Rivard, W.S. Adney, T.B. Vinzant, M.E. Himmel, C.E. Wyman, and K. Grohmann, The 1989 ASM Annual Meeting, Poster O50, New Orleans, LA, May (1989).
48. "Cellulase Production by *Acidothermus cellulolyticus*", M. Shiang, J. Linden, A. Mohagheghi, K. Grohmann, and M.E. Himmel, The 11th Symposium on Biotechnology for Fuels and Chemicals, Poster No. 50, Colorado Springs, CO, May (1989).
49. "Monoclonal Antibody Affinity Purification of *Trichoderma reesei* EG I", R.A. Nieves, M.E. Himmel and R.P. Ellis, The 11th Symposium on Biotechnology for Fuels and Chemicals, Poster No. 60, Colorado Springs, CO, May (1989).
50. "Production of Monoclonal Antibody Specific for Endoglucanases I and Cellobiohydrolase II of *Trichoderma reesei*", R.A. Nieves, R.P. Ellis, and M.E. Himmel, The 1989 ASM Annual Meeting, Poster O7, New Orleans, LA, May (1989).
51. "Inter-molecular Crosslinking of Fungal Beta-Glucosidase", J.O. Baker, D.J. Mitchell, K. Tatsumoto, K. Grohmann, and M.E. Himmel, The 11th Symposium on Biotechnology for Fuels and Chemicals, Poster No. 78, Colorado Springs, CO, May (1989).
52. "Dilute Acid Pretreatment of Short Rotation Woody and Herbaceous Crops", R. Torget, P. Werdene, M.E. Himmel and K. Grohmann, The 11th Symposium on Biotechnology for Fuels and Chemicals, Poster No. 44, Colorado Springs, CO, May (1989).
53. "Characterization and Augmentation of Polysaccharidase Activity in the Anaerobic Digestion of Municipal Solid Waste", W.S. Adney, C.J. Rivard, M.E. Himmel, T.B. Vinzant, and K. Grohmann, The ASM Conference on Biotechnology, Poster No. 35, Orlando, FL, June (1989).
54. "Biodegradation of Plastic-Copolymers", C.J. Rivard, T. Vinzant, M.E. Himmel, and K. Grohmann, presented at the Second Annual Colorado Biotechnology Symposium, Boulder, CO, September (1989).
55. "Evaluation of Alkaline Earth and Transition Metals for Coordination in Ion Moderated Partition Chromatography of Sugars", G.R. Noll, N. Nagle, D.J. Mitchell, J.O. Baker, K. Grohmann, and M.E. Himmel, poster at the Second Annual Colorado Biotechnology Symposium, Boulder, CO, September (1989).
56. "Cellulase Production by *Acidothermus cellulolyticus*", M. Shiang, A. Mohagheghi, M.E. Himmel, and J.C. Linden, poster at the Second Annual Colorado Biotechnology Symposium, Boulder, CO, September (1989).
57. "Interactions of Pretreated Substrates with Cellulase Systems from *Trichoderma reesei* and Anaerobic Bacteria", K. Grohmann, C.J. Rivard, W.S. Adney, T.B. Vinzant, D.J. Mitchell, and M.E. Himmel, presented at TRICEL 1989, Graz, Austria, September (1989).
58. "Production of Enzyme-Specific Monoclonal Antibodies for *Trichoderma reesei* Cellulases", R.A. Nieves, R.P. Ellis, and M.E. Himmel, poster at the 1989 Rocky Mountain Regional Meeting of the ASM, Westminster, CO, October (1990).
59. "Cellulase Production by *Acidothermus cellulolyticus*", M. Shiang, J. Linden, A. Mohagheghi, K. Grohmann, and M.E. Himmel, poster at the 1989 Rocky Mountain Regional Meeting of the ASM, Westminster, CO, October (1989).

60. "Cellulase Production by *Acidothermus cellulolyticus*: Growth on Solka Floc Cellulose and Simple Sugar Mixtures", M. Shiang, J. Linden, A. Mohagheghi, M.E. Himmel, M.P. Tucker, and K. Grohmann, presented at the 1990 Annual ACS Meeting, Boston, MA, April (1990).
61. "Enzymes for Fuels and Chemical Feedstocks", K. Grohmann and M.E. Himmel, presented at the 1990 Annual ACS Meeting, Symposium on Enzymes from Biomass, Boston, MA, April (1990).
62. "Enhanced Utilization of Enzymes: Immobilization and Chemical Crosslinking", D.J. Mitchell, J.O. Baker, K. Grohmann, and M.E. Himmel, presented at the 1990 Annual ACS Meeting, Symposium on Enzymes from Biomass, Boston, MA, April (1990).
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64. "Isolation and Characterization of Two Chromatographic Forms of β -D-Glucosidase from *Aspergillus niger*", M.E. Himmel, D.J. Mitchell, J.W. Fox, J.O. Baker, W.S. Adney, K. Tatsumoto, G.R. Noll, and K. Grohmann, poster No. 70 at the Twelfth Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN, May (1990).
65. "Dilute Acid Pretreatment of Corn Residues and Short Rotation Crops", R. Torget, P. Werdene, M.E. Himmel, and K. Grohmann, poster No. 44 at the Twelfth Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN, May (1990).
66. "Effects of Digester Operational Temperature and Feedstock Cellulose Content on Hydrolytic Enzyme Levels and Optima in CSTR Digesters Fed Municipal Solid Waste", W.S. Adney, C.J. Rivard, M.E. Himmel, poster No. O71 at the 1990 American Society for Microbiology Meeting in Anaheim, CA, May (1990).
67. "Anaerobic Biodegradation of Starch Acetate and Cellulose Acetate Plastic Copolymers", C.J. Rivard, T.B. Vinzant, W.S. Adney, M.E. Himmel, K. Grohmann, National Corn Growers Association, St. Louis, MO, June (1990).
68. "Production of Fuel Ethanol by Enzymatic Hydrolysis of Cellulosic Biomass", K. Grohmann, M.E. Himmel, N. Hinman, and C.E. Wyman, presented at the 1990 ACS Meeting, Washington, DC, August (1990).
69. "Thermal Unfolding of *Trichoderma reesei* CBH I", J.O. Baker, D.J. Mitchell, K. Grohmann and M.E. Himmel, presented at the Third Annual Colorado Biotechnology Symposium, Fort Collins, CO, September (1990).
70. "Anaerobic Biodegradation of Natural Polymers: Effects of Acetate Substitution", C.J. Rivard, W.S. Adney, M.E. Himmel, D.J. Mitchell, K. Grohmann, L. Moens, and H.L. Chum, Presented at the AIChE Annual Meeting, Biological Degradation of Plastics Session, Chicago, IL, November (1990).
71. "Thermal Denaturation of *Trichoderma reesei* Cellulases Studied by Differential Scanning Calorimetry and Tryptophan Fluorescence", J.O. Baker, K. Tatsumoto, K. Grohmann, J. Woodward, J.M. Wichert, S.P. Shoemaker, and M.E. Himmel, Presented at the Thirteenth Symposium on Biotechnology for Fuels and Chemicals, Poster No. 23, Colorado Springs, CO, May (1991).
72. "Efficacy of Thermo-chemical Pretreatments and Hydrolytic Enzyme Augmentation for Increased Secondary Anaerobic Digestion of Municipal Sewage Sludges", N.J. Nagle, C.J. Rivard, W.S. Adney, M.E. Himmel, and K. Grohmann, Presented at the Thirteenth Symposium on Biotechnology for Fuels and Chemicals, Poster No. 94, Colorado Springs, CO, May (1991).
73. "Effects of Increasing Acetylation of Natural Polymers on the Anaerobic Bioconversion to Methane and Carbon Dioxide", C.J. Rivard, W.S. Adney, M.E. Himmel, D.J. Mitchell, K. Grohmann, L. Moens, and H.L. Chum, Presented at the Thirteenth Symposium on Biotechnology for Fuels and Chemicals, Poster No. 93, Colorado Springs, CO, May (1991).
74. "Dilute Acid Pretreatment of Two Short Rotation Herbaceous Crops", R. Torget, M.E. Himmel, and K. Grohmann, Presented at the Thirteenth Symposium on Biotechnology for Fuels and Chemicals, Poster No. 4, Colorado Springs, CO, May (1991).
75. "Effects of Enzymatic Augmentation/Detergent Treatments on the Anaerobic Biodegradation of Highly Acetylated Natural Polymers", W.S. Adney, C.J. Rivard, and M.E. Himmel, Presented at the 1991 ASM Conference on Biotechnology, New York, NY, June 1991.
76. "Secondary Anaerobic Digestion of Treated, Highly Dewatered Municipal Sewage Sludges Using a Novel High Solids Reactor", C.J. Rivard, N.J. Nagle, and M.E. Himmel, Presented at the 1991 Annual Meeting of the American Chemical Society, Session on Biotechnology for Waste Water Treatment, Atlanta, GA, April 1991.
77. "Thermal and pH Stress in Denaturation of Cellobiohydrolase I: Pre-Denaturational Structural Changes", J.O. Baker and M.E. Himmel, Presented at the Fourth International Chemical Congress/ACS National Meeting, New York, NY, August 29, 1991.
78. "Effects of Pretreatment Technologies on the Secondary Anaerobic Digestion of Municipal Sewage Sludge Residues", N.J. Nagle, C.J. Rivard, and M.E. Himmel, presented at the Fourth Annual Colorado Biotechnology Symposium, Boulder, CO, September (1991).

79. "Visualization of *Trichoderma reesei* CBH I and EG I on Aspen Cellulose using MAb-Colloidal Gold Conjugates", R.A. Nieves, R.P. Ellis, R.J. Todd, T.J.A. Johnson, K. Grohmann, and M.E. Himmel, presented at the 1991 Rocky Mountain Regional Meeting of the ASM, Westminster, CO, September (1991).
80. "Thermal and pH Stress in Thermal Denaturation of *Trichoderma reesei* CBH I: Supporting Evidence for a Two-Transition Model", J.O. Baker and M.E. Himmel, Presented at the Cellulose '91 meeting organized by the ACS and Cellucon Conferences, New Orleans, LA, December (1991).
81. "Molecular Weight Distribution of Lignins by HPSEC", M.E. Himmel, Presented at the Pre-Symposium workshop, ("Modern Methods of Analysis of Wood, Annual Plants, and Lignins") organized by NREL and IEA, New Orleans, LA, December (1991).
82. "Isolation and Purification of a β -D-Glucosidase from *Aspergillus niger*", M.E. Himmel, W.S. Adney, D.J. Mitchell, and J.O. Baker, The Fourteenth Symposium on Biotechnology for Fuels and Chemicals, Poster No. 63, Gatlinburg, TN, May (1992).
83. "Anaerobic Bioconversion of Municipal Solid Wastes: Effects of Total Solids Levels on Microbial Numbers and Hydrolytic Enzyme Activities", C.J. Rivard, N.J. Nagle, W.S. Adney, and M.E. Himmel, The Fourteenth Symposium on Biotechnology for Fuels and Chemicals, Poster No. 41, Gatlinburg, TN, May (1992).
84. "Partial Purification of Cellulases by Preparative Native Gel Electrophoresis", R.A. Nieves, W.S. Adney, and M.E. Himmel, 1992 ASM General Meeting, New Orleans, LA, May (1992).
85. "Cellulase Assays: Review and Testing", M.E. Himmel, W.S. Adney, and J.O. Baker, To be presented at the IGT meeting on "Energy From Biomass and Wastes XVI", Orlando, FL (1992).
86. "Purification of Cellulases by Preparative Native Gel Electrophoresis", R.A. Nieves, W.S. Adney, and M.E. Himmel, Poster No. III. 6, The Fifth Annual Colorado Biotechnology Symposium, Fort Collins, CO, September (1992).
87. "Codon Usage in *Acidothermus cellulolyticus*: Preliminary Comparisons", R.A. Laymon, S.R. Thomas, M.P. Tucker, T. Vinzant, and M.E. Himmel, Poster III. 18, The Fifth Annual Colorado Biotechnology Symposium organized by CIRB, Colorado State University, Fort Collins, CO, September (1992).
88. "SSF Comparison of Selected Woods from Southern Saw Mills", L.R. Ponfick, T. Vinzant, N.J. Nagle, T.I. Ehrman, K.M. Magill, J.B. Reynolds, and M.E. Himmel, Poster No. III. 19, The Fifth Annual Colorado Biotechnology Symposium organized by CIRB, Colorado State University, Fort Collins, CO, September (1992).
89. "Estimation of Total Microbial Numbers and Hydrolytic Enzyme Activities: Comparison of Low Solids and High Solids Digestion Systems", C.J. Rivard, N.J. Nagle, and M.E. Himmel, Poster No. 20, The Fifth Annual Colorado Biotechnology Symposium organized by CIRB, Colorado State University, Fort Collins, CO, September (1992).
90. "Cellulase Research for DOE", M.E. Himmel, The 1992 Automotive Technology Development Contractors Coordination Meeting, Dearborn, MI, November 2-5, 1992.
91. "Monoclonal Antibodies Against Elk, Mule Deer, White Tailed Deer, and Antelope Albumins", R.P. Ellis, R.J. Todd, K.L. Cannizzo, W.J. Adrian, E.L. Belden, R.A. Schamber, R.A. Nieves, and M.E. Himmel, The Northwest Association of Forensic Scientists, Portland, OR, October, 1992.
92. "Purification and Characterization of Acetyl-Xylan Esterase from *Aspergillus niger*", James C. Linden, Meropi Samara, Miklos Pecs, Ellen Thomas, Michelle Joy, William Adney, and Michael E. Himmel, The symposium on "The Extracellular Matrix of Plants: Molecular, Cellular, and Developmental Biology," Santa Fe, NM, January, 1993.
93. "Endoglucanase E1 from *Acidothermus cellulolyticus* is a Family A Cellulase", S.R. Thomas, R.A. Laymon, M.P. Tucker, T.B. Vinzant, and M.E. Himmel, "Recombinant DNA II", 1993 Engineering Foundation Meeting, Palm Coast, FL, February, 1993.
94. "Visualization of Cellulases Bound to Cellulose Protofibrils: Evidence for Endo/Exo Synergism", Rafael A. Nieves, Robert P. Ellis, and Michael E. Himmel, The symposium on "Bioconversion for Fuels", The 1993 Annual American Chemical Society meeting, Denver, CO, March, 1993.
95. "Cellulase Assays: Methods from Empirical Mathematical Models", William S. Adney, John O. Baker, and Michael E. Himmel, The symposium on "Bioconversion for Fuels", The 1993 Annual American Chemical Society meeting, Denver, CO, March, 1993.
96. "Endoglucanase E1 from *Acidothermus cellulolyticus*: Biochemical Characterization, Cloning, and Restriction Mapping", W.S. Adney, M.P. Tucker, R.A. Nieves, R.A. Laymon, J.O. Baker, T.B. Vinzant, S.L. Lastick, S.R. Thomas, and M.E. Himmel, The symposium on "Bioconversion for Fuels", The 1993 Annual American Chemical Society meeting, Denver, CO, March, 1993.
97. "Anaerobic Digestion of Municipal Solid Waste: Analysis of Cellulosic Biodegradative Power", C.J. Rivard, N.J. Nagle, R.A. Nieves, and M.E. Himmel, The symposium on "Bioconversion for Fuels" held at the 1993 Annual American Chemical Society meeting, Denver, CO, March, 1993.

98. "Endoglucanase E1 from *Acidothermus cellulolyticus* is a Family A Cellulase," S.R. Thomas, R.A. Laymon, M.P. Tucker, T.B. Vinzant, W.S. Adney, R.A. Nieves, J.O. Baker, and M.E. Himmel, The Fifteenth Symposium on Biotechnology for Fuels and Chemicals, Colorado Springs, CO, May, 1993.
99. "Synergism Studies of Bacterial and Fungal Cellulases at Low Total Cellulase Loadings", J.O. Baker, W.S. Adney, R.A. Nieves, D.B. Wilson, S.R. Thomas, and M.E. Himmel, The Fifteenth Symposium on Biotechnology for Fuels and Chemicals, Colorado Springs, CO, May, 1993.
100. "SSF Comparison of Selected Woods from Southern Saw Mills", T.B. Vinzant, L.R. Ponfick, N.J. Nagle, C.I. Ehrman, K.M. Magill, J.B. Reynolds, and M.E. Himmel, The Fifteenth Symposium on Biotechnology for Fuels and Chemicals, Colorado Springs, CO, May, 1993.
101. "Purification and Characterization of Acetyl-Xylan Esterase from *Aspergillus niger*," James C. Linden, Meropi Samara, Miklos Pecs, Ellen Thomas, Michelle Joy, William Adney, and Michael E. Himmel, The Fifteenth Symposium on Biotechnology for Fuels and Chemicals, Colorado Springs, CO, May, 1993.
102. "Evaluation of Discrete Cellulase Enzyme Activities from Anaerobic Digester Sludge Fed a Municipal Solid Waste Feedstock," C.J. Rivard, R.A. Nieves, N.J. Nagle, and M.E. Himmel, The Fifteenth Symposium on Biotechnology for Fuels and Chemicals, Colorado Springs, CO, May, 1993.
103. "Cellulase Research for the DOE Biofuels Program," M.E. Himmel, N.D. Hinman, and S.R. Thomas, distributed at The IEA-Symposium on Biotechnology for the Conversion of Lignocellulosics, Helsinki, FINLAND, June 6-9, 1993.
104. "The Cellulase Synergistic Effect: Assembly of Optimal Biochemical Systems", S.R. Thomas, J.O. Baker, W.S. Adney, R.A. Nieves, M.P. Tucker, T.B. Vinzant, D.B. Wilson, D.E. Eveleigh, and M.E. Himmel, The Society for Industrial Microbiology & Canadian Society of Microbiologists, Toronto, CANADA, July, 1993.
105. "Initial Approaches to Artificial Cellulase Systems for Conversion of Biomass to Ethanol," S.R. Thomas, R.A. Laymon, Y.-C. Chou, M.P. Tucker, T.B. Vinzant, W.S. Adney, J.O. Baker, R.A. Nieves, and M.E. Himmel, The symposium on *Advances in the Bioconversion of Lignocellulosics*, Presented as an oral paper at The 1994 Annual American Chemical Society Meeting, San Diego, CA, March, 1994.
106. "The Cellulase Synergistic Effect: Binary and Ternary Systems," J.O. Baker, S.R. Thomas, W.S. Adney, R.A. Nieves, and M.E. Himmel, The symposium on *Enzymic Degradation of Insoluble Polysaccharides*, Presented as an oral paper at The 1994 Annual American Chemical Society Meeting, San Diego, CA, March, 1994.
107. "Immunogold Labeling of a Recombinant Thermophilic Bacterial Endoglucanase Expressed in *Escherichia coli* Using Monoclonal Antibody," R.A. Nieves, M.P. Tucker, R.A. Laymon, S.R. Thomas, and M.E. Himmel, Presented as an oral paper at the 1994 Annual Meeting of the American Society of Microbiology, Las Vegas, May, 1994.
108. "Quantitation of *Acidothermus cellulolyticus* E1 endoglucanase and *Thermomonospora fusca* E3 Exoglucanase Using Enzyme-Linked Immunosorbent Assays (ELISA)," R.A. Nieves, Y.-C. Chou, D.B. Wilson, S.R. Thomas, and M.E. Himmel, Presented as a poster at The Sixteenth Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN, May, 1994.
109. "Horsepower Requirements for High Solids Anaerobic Digestion", C.J. Rivard, B.X. Kay, D.X. Kerbaugh, N.J. Nagle, and M.E. Himmel, Presented as a poster at The Sixteenth Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN, May, 1994.
110. "*Acidothermus cellulolyticus* E1 Endoglucanase: Characteristic of Native and Recombinant Forms", S.R. Thomas, W.S. Adney, J.O. Baker, Y.-C. Chou, R. Laymon, R.A. Nieves, M.P. Tucker, T.B. Vinzant, and M.E. Himmel, Presented as a poster at The Sixteenth Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN, May, 1994.
111. "The Gene Encoding the *Acidothermus cellulolyticus* E1 Endoglucanase", R.A. Laymon, S.R. Thomas, T.B. Vinzant, W.S. Adney, and M.E. Himmel, Poster No. 21, The 7th Annual Colorado Biotechnology Symposium organized by CIRB, Colorado State University, Fort Collins, CO, September, 1994.
112. "Kinetic Comparison of β -D-glucosidases of Industrial Importance", W.S. Adney, J.O. Baker, T.B. Vinzant, S.R. Thomas, and M.E. Himmel, Presented as an oral paper at the 1995 Annual Meeting of the American Chemical Society, Anaheim, CA, April, 1995.
113. "Cloning and Expression of the *Acidothermus cellulolyticus* E1 β -1,4-Endoglucanase Gene in *Streptomyces lividans*," Y.-C. Chou, T.B. Vinzant, R.A. Nieves, M.E. Himmel, and S.R. Thomas, Presented as Poster No.60 at the 17th Annual Symposium on Biotechnology for Fuels and Chemicals, Vail, CO, May 1995.
114. "The Commissioning of a Pilot-Scale Reactor for Dilute-Acid Pretreatment," T. Hsu, M. Himmel, J. Farmer, C. Wyman, and M. Berggren, Presented as an oral paper at the 17th Annual Symposium on Biotechnology for Fuels and Chemicals, Vail, CO, May 1995.
115. "Cloning and Expression of Full Length *Trichoderma reesei* Cellobiohydrolase (CBH) I cDNAs in *E. coli*," R.A. Laymon, A. Mohagheghi, M.E.

- Himmel, and S.R. Thomas, Presented as poster No.80 at the 17th Annual Symposium on Biotechnology for Fuels and Chemicals, Vail, CO, May 1995.
116. "Synergism and Soluble-Sugar Production in Hybrid Cellulase Systems," J.O. Baker, W.S. Adney, R.A. Nieves, S.R. Thomas, and M.E. Himmel, Presented as poster No.57 at the 17th Annual Symposium on Biotechnology for Fuels and Chemicals, Vail, CO, May 1995.
 117. "Evaluation of Commercial Cellulase Preparations for Use in Ethanologenic Fermentations of Cellulosic Biomass," R.A. Nieves, W.S. Adney, C.I. Ehrman, S.R. Thomas, and M.E. Himmel, Presented as Poster No.85 at the 17th Annual Symposium on Biotechnology for Fuels and Chemicals, Vail, CO, May 1995.
 118. "Advances in Cellulase Research," S.R. Thomas, W.S. Adney, J.O. Baker, Y.-C. Chou, R.A. Laymon, R.A. Nieves, T.B. Vinzant, X. Xiong, and M.E. Himmel, Presented as an oral paper at the 1995 Annual Meeting of the American Society of Microbiology, Washington, DC, May, 1995.
 119. "A Novel Survey and Analysis of Commercial Cellulase Preparations Suitable for Biomass Conversion to Ethanol," R.A. Nieves, W.S. Adney, C.I. Ehrman, S.R. Thomas, and M.E. Himmel, Presented as a poster at the 1995 Annual Meeting of AiChE, Boston, MA, June, 1995.
 120. "Progress in the Development of Novel Cellulase Production Systems," S.R. Thomas, W.S. Adney, J.O. Baker, Y.-C. Chou, R.A. Laymon, R.A. Nieves, T.B. Vinzant, X. Xiong, and M.E. Himmel, An oral paper given at the Second Biomass of the Americas Symposium, *Energy, Environment, Agriculture, and Industry*, Portland, OR, August, 1995.
 121. "*Acidothermus cellulolyticus*, gen. nov., sp. nov.: Utilization of Cellulose at Hot Spring Temperatures," W.S. Adney, R.A. Nieves, S.R. Thomas, A. Mohagheghi, M.P. Tucker, T.B. Vinzant, and M.E. Himmel, An oral paper to be presented at the symposium on *Biodiversity, Ecology, and Evolution of Thermophiles in Yellowstone National Park: An Overview and Issues*, Old Faithful Lodge, September, 1995.
 122. "Expression of *Microbispora bispora* Bgl B in *Streptomyces lividans*," X. Xiong, W.S. Adney, T.B. Vinzant, Y.-C. Chou, M.E. Himmel, and S.R. Thomas, The 8th Annual Colorado Biotechnology Symposium organized by CIRB, Colorado State University, Fort Collins, CO, September, 1995.
 123. "Progress Toward the Production of Low Cost Cellulase Preparations for Biomass Conversion," M.E. Himmel, J.O. Baker, W.S. Adney, V.L. Putsche, and S.R. Thomas, An oral paper Presented at The 1995 International Chemical Congress of Pacific Basin Societies Symposium on *Pretreatment and Hydrolysis of Biomass*, Honolulu, Hawaii, December, 1995.
 124. "Biomass to Ethanol Conversion Technologies in the U.S.," J.R. Mielenz, G.P. Philippidis, Q. Nguyen, C. Hatzis, S.R. Thomas, S.K. Picataggio, J.D. McMillan, R.T. Elander, D. Koepping, F. Parson, C.E. Wyman, and M.E. Himmel, A poster Presented at The 1995 International Chemical Congress of Pacific Basin Societies Symposium, IEA Symposium on *Bioconversion of Lignocellulosics*, Honolulu, Hawaii, December, 1995.
 125. "Cellulase Superfolds: Diversity of Structure and Convergence of Function," M.E. Himmel, J.O. Baker, W.S. Adney, R.A. Nieves, and S.R. Thomas, Presented at the 18th Annual Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN, May 1996.
 126. "A Membrane Reactor Saccharification Assay to Evaluate the Performance of Cellulases and Substrate Pretreatments under Simulated SSF Conditions," J.O. Baker, W.S. Adney, T.B. Vinzant, Y.-C. Chou, R.A. Nieves, S.R. Thomas, and M.E. Himmel, Presented at the 18th Annual Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN, May 1996.
 127. "A Membrane Reactor Saccharification Assay to Evaluate the Performance of Cellulases Under Simulated SSF Conditions," J.O. Baker, W.S. Adney, T.B. Vinzant, C.I. Ehrman, Y.-C. Chou, R.A. Nieves, S.R. Thomas, and M.E. Himmel, Presented at the The 9th Annual Colorado Biotechnology Symposium organized by CIRB, Colorado State University, Fort Collins, CO, September, 1996.
 128. "Hydrolysis of Cellulose Using Ternary Mixtures of Purified Cellulases," J.O. Baker, C.I. Ehrman, W.S. Adney, S.R. Thomas, and M.E. Himmel, Presented at the Nineteenth Symposium on Biotechnology for Fuels and Chemicals, Colorado Springs, CO, May, 1997.
 129. "Formation of Transglycosylation Products During the Enzymatic Saccharification of Corn Biomass to Ethanol," R.A. Nieves, C.I. Ehrman, R.T. Elander, and M.E. Himmel, Presented at the Nineteenth Symposium on Biotechnology for Fuels and Chemicals, Colorado Springs, CO, May, 1997.
 130. "Technoeconomic Evaluation of Integrated *Trichoderma reesei* Cellulase Production Technology for Bioethanol Production," David A. Glassner, Robert J. Wooley, Todd B. Vinzant, and Michael E. Himmel, Presented at the Nineteenth Symposium on Biotechnology for Fuels and Chemicals, Colorado Springs, CO, May, 1997.
 131. "Aerobic Microbial Isolates Originating from Yellowstone Hot Springs: Survey of Non-cellulosic Polysaccharide Hydrolyzing Ability," S.R. Decker, W.S. Adney, T.B. Vinzant, and M.E. Himmel, Presented at the Nineteenth Symposium on Biotechnology for Fuels and Chemicals, Colorado Springs, CO, May, 1997.
 132. "Engineering Effective Cellulase Systems for Bioethanol Production," Michael E. Himmel, William S. Adney, John O. Baker, Rafael A. Nieves,

Todd B. Vinzant, and Steven R. Thomas, Presented at the Annual SIM Meeting in Reno, NE, August, 1997.

133. "Engineering Cellulase Systems: Enzyme Modifications For Improved Function," M.E. Himmel, W.S. Adney, J.O. Baker, S.R. Decker, T.B. Vinzant, R.A. Nieves, S. Godbole, and S.R. Thomas. Invited presentation at the Special Symposium *Structure and Function of Microbial Cellulases*, The 98th General Meeting of the American Society for Microbiology, Atlanta, GA, May 1998.
134. "Substrate-Specific Induction and Characterization of Cellulases From *Trichoderma reesei*," T.B. Vinzant, W.S. Adney, S.R. Decker, J.O. Baker, R.A. Nieves, and M.E. Himmel, Presented at the 20th Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN, May, 1998.
135. "Interactions Between *Acidothermus cellulolyticus* Endoglucanase I and *Trichoderma reesei* CBH I in the Saccharification of Microcrystalline Cellulose and Dilute-Acid-Pretreated Yellow Poplar," J.O. Baker, W.S. Adney, S.R. Decker, C.I. Ehrman, T.B. Vinzant, and M.E. Himmel, Presented at the 20th Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN, May, 1998.
136. "Isolation and Characterization of *T. reesei* CBH I Cloned in *Pichia pastoris*," S. Godbole, S.R. Thomas, R.A. Nieves, W.S. Adney, T.B. Vinzant, and M.E. Himmel, Presented at the 20th Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN, May, 1998.
137. "Discovery and Comparison of Thermophilic and Mesophilic Polysaccharidases for Industrial Applications," S.R. Decker, W.S. Adney, T.B. Vinzant, and M.E. Himmel, Presented at the 20th Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN, May, 1998.
138. "More Effective, Less Expensive Enzymes for Biomass Conversion Processes," S.R. Thomas, W.S. Adney, J.O. Baker, S. Decker, S. Godbole, M.E. Himmel, R.A. Nieves, M. Ruth, T.B. Vinzant, SIM Meeting, 8/98, Denver, CO.
139. "Improved Cellulases for Bioethanol Production," M.E. Himmel, W.S. Adney, J.O. Baker, S.R. Decker, T.B. Vinzant, R.A. Nieves, and S.R. Thomas, Tenth CIFAR Conference entitled "Enzyme Innovations for Food and Agriculture," UC Davis, Davis, CA, October 9, 1998.
140. "Protein Engineering for Bioethanol Production," M.E. Himmel, W.S. Adney, J.O. Baker, S.R. Decker, T.B. Vinzant, R.A. Nieves, and S.R. Thomas, DOE Laboratory Catalysis Research Symposium, Albuquerque, NM, Feb. 24-25, 1999.
141. "Cellulase Action As Viewed Using An Analytical Membrane-Reactor Assay," J.O. Baker, M.R. King, W.S. Adney, T.B. Vinzant, S.R. Decker, J. Sakon, and M.E. Himmel, Annual ACS Meeting in Anaheim, CA. March 12-15, 1999.
142. "Designing Catalytically Enhanced Endocellulase," J. Sakon, J. McCarley, R. Lovett, W.S. Adney, J.O. Baker, and M.E. Himmel, Annual ACS Meeting in Anaheim, CA. March 12-15, 1999.
143. "Engineering Cellulases: Endoglucanase Modifications For Improved System Function," W.S. Adney, J.O. Baker, S.R. Decker, T.B. Vinzant, R.A. Nieves, S.R. Thomas, and M.E. Himmel, The 21st Symposium on Biotechnology for Fuels and Chemicals, Fort Collins, CO May, 1999.
144. "Preliminary Economic Analysis of Agricultural Enzyme Production for Use in Cellulose Hydrolysis," M.F. Ruth, J.A. Howard, Z. Nikolov, B.S. Hooker, M.E. Himmel, and S.R. Thomas, The 21st Symposium on Biotechnology for Fuels and Chemicals, Fort Collins, CO May, 1999.
145. "Biomass Conversion by *Trichoderma reesei* Cellulase: Analysis by 2-D Gel Electrophoresis," T.B. Vinzant, W.S. Adney, S.R. Decker, M.R. King, J.O. Baker, M.T. Kinter, N.E. Sherman, J.W. Fox, and M.E. Himmel, The 21st Symposium on Biotechnology for Fuels and Chemicals, Fort Collins, CO May, 1999.
146. "Improved Cellulases for Bioethanol Production," M.E. Himmel, W.S. Adney, S.R. Decker, T.B. Vinzant, R.A. Nieves, S.R. Thomas, and J.O. Baker. Gordon Research Conference on "Cellulases and Cellulosomes," Proctor Academy, New Hampshire, July 25-30, 1999.
147. "Improved Cellulases for Bioethanol Production," W.S. Adney, J.O. Baker, S.R. Decker, S.L. McCarter, J. Sheehan, T.B. Vinzant, and M.E. Himmel, Presented at Wood and Cellulose: Building Blocks for Chemicals, Fuels, and Advanced Materials, SUNY College of Environmental Science & Forestry, Syracuse, NY, April 9-11, 2000.
148. "Heterologous Expression of *Trichoderma reesei* CBH I: Effect of Site-Directed Mutations on Expression and Thermostability" S.R. Decker, W.S. Adney, J.O. Baker, S.L. McCarter, T.B. Vinzant, J. Sakon*, K.L. Barnett, and M.E. Himmel, The 22nd Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN May, 2000.
149. "Site-Directed Mutagenesis of the EI Endoglucanase from *Acidothermus cellulolyticus*", S.L. McCarter, W.S. Adney, J.O. Baker, T.B. Vinzant, R.D. Guckian, S.R. Decker, J. Sakon*, and M.E. Himmel, The 22nd Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN May, 2000.
150. "Thermophilic Bacteria of the Kamchatka Peninsula as Producers of Carbohydrate Degrading Enzymes," W.S. Adney, M.E. Himmel, I. Andreeva, N. Pechurkina, G. Karpov, and V. Repin, Combined Rocky Mountain and Pacific ACS Regional Meeting, Idaho Falls, Idaho, June 14, 2000.

151. "Development of a Total Cellulytic Activity Assay for High Throughput Screening," Vargas, José Manuel [Presenter], Carlos Flores, Yamir Diaz, Eli Tilén, Edwin G. Rivera, and L. Saliceti-Piazza, Department of Chemical Engineering, University of Puerto Rico, Mayagüez, Puerto Rico; Catalina Flores, Department of Chemical Engineering, Iowa State University, Ames, IA; and R. Nieves, M. Himmel, and S. Decker, National Renewable Energy Laboratory, Golden, CO. Paper No. 164-15s, National Student Poster Session, 2000 Annual AIChE Meeting, Los Angeles, CA. November 12-17, 2000.
152. "High-Throughput Screening of Cellulases: Automated Filter Paper Assay and Beyond," Stephen R. Decker*, Edward W. Jennings, William S. Adney, Todd B. Vinzant, Suzanne L. McCarter, John O. Baker, and Michael E. Himmel, The 23rd Symposium on Biotechnology for Fuels and Chemicals, Breckenridge, CO May, 2001.
153. "Characterization of Starch Degrading Enzymes from a Marine Bacterium." Diana Franqui-Espiet, Govind S. Nadathur*, William S. Adney, Suzanne L. McCarter, Rafael A. Nieves, Todd B. Vinzant, and Michael E. Himmel, The 23rd Symposium on Biotechnology for Fuels and Chemicals, Breckenridge, CO May, 2001.
154. "Discovery Of Industrial Enzymes From Thermophilic Bacteria Of The Kamchatka Peninsula" W.S. Adney, I. Andreeva*, N. Pechurkina*, G. Karpov**, D. Franqui-Espiet, M.E. Himmel, and V. Repin, The 23rd Symposium on Biotechnology for Fuels and Chemicals, Breckenridge, CO May, 2001.
155. Effect of a Single Active-Site-Cleft Mutation upon Product Specificity in a Thermostable Bacterial Cellulase. Tauna R. Rignall, John O. Baker, William S. Adney, Suzanne L. McCarter, Todd B. Vinzant, Steven R. Decker, and Michael E. Himmel, The 23rd Symposium on Biotechnology for Fuels and Chemicals, Breckenridge, CO May, 2001.
156. Substrate Interactions Displayed by a Surface-Modified Endoglucanase from *A. cellulolyticus*. Suzanne L. McCarter, William S. Adney, Todd B. Vinzant, Fannie Posey-Eddy, John O. Baker, Tauna Rignall, Joshua Sakon*, and Michael E. Himmel., The 23rd Symposium on Biotechnology for Fuels and Chemicals, Breckenridge, CO May, 2001
157. "Cellulase/cellulose interaction: Site directed surface modifications of a family 5 endoglucanase". Suzanne L. McCarter, William S. Adney, Todd B. Vinzant, Fannie Posey-Eddy, John O. Baker, Tauna Rignall, Joshua Sakon, and Michael E. Himmel, SIM Annual Meeting., July 25-30, 2001.
158. "Diversity and Conservation of Relevant GH Families in Well-Studied Cellulolytic Microbes," S.-Y. Ding, W.S. Adney, S.M. McCarter, S.R. Decker, T.B. Vinzant, and M.E. Himmel. Gordon Research Conference on "Cellulases and Cellulosomes," Poster A3, Proctor Academy, New Hampshire, July 25-Aug 3, 2001.
159. "Temperature and Enzyme Loadings as Variables in Cellulase Kinetics," J.O. Baker, Tauna R. Rignall, William S. Adney, Suzanne L. McCarter, Todd B. Vinzant, Steven R. Decker, and Michael E. Himmel. Gordon Research Conference on "Cellulases and Cellulosomes," Proctor Academy, New Hampshire, July 25-Aug 3, 2001.
160. "Enzymatic Depolymerization of Biomass Carbohydrates: New Perspective", M.E. Himmel, Fifth Biomass Conference of the Americas, Orlando, FL, September 17-21, 2001.
161. "Improved Cellulases Through Protein Engineering," M.E. Himmel, J. Brady, J. Sakon, W.S. Adney, S. McCarter, S.R. Decker, T.B. Vinzant, T. Rignall, J.O. Baker, C. Skopec, and S.-Y. Ding. A. Payen Special Symposium Honoring Liisa Viikari, Application of Enzymes to Lignocellulosics, 223rd Annual ACS Meeting, Orlando, FL. April 7-10, 2002.
162. "Utility of Cellobiose Dehydrogenase in the Automated Measurement of Cellulolytic Activity, Stephen R. Decker, Edward W. Jennings, Todd B. Vinzant, William S. Adney, and Michael E. Himmel, The 24nd Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN May, 2002.
163. "New Glycosyl Hydrolases from *Acidothermus cellulolyticus*, Shi-You Ding, William S. Adney, Stephen R. Decker, John O. Baker, Ed Jennings, Todd B. Vinzant, and Michael E. Himmel, The 24nd Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN May, 2002.
164. "Proteases and the Extracellular Lignin Depolymerase Activity from *Trametes cingulata*, Yi-ru Chen, Todd B. Vinzant,* Stephen R. Decker,* Ed Jennings,* Michael E. Himmel,* and Simo Sarkanen, The 24nd Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN May, 2002.
165. "Changes in Cellulose Morphology of Pretreated Yellow Poplar During Enzymatic Hydrolysis," Mark Davis, John Baker Tauna Rignall, and Michael Himmel, The 24nd Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN May, 2002.
166. "Expression of Endoglucanase E1 in Transgenic Duckweed *Lemna minor*," Ye Sun, William S. Adney, Ben A. Bergmann, Jiayang Cheng, Stephen R. Decker, Shelby Freer, Michael E. Himmel, Yufuko Nishimura, Christopher D. Skory, Anne-Marie Stomp, Steven Thomas, Brent Tisserat, Yuri T. Yamamoto, The 24th Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN May, 2002.

167. "Conjugation of Self-Assembling Proteins to CdSe/ZnS Quantum Dots. S.-Y. Ding, G. Rumbles, W.S. Adney, M. Jones, J. Nedeljkovic, M.P. Tucker, A.J. Nozik, and M.E. Himmel, 25th DOE OS Photochemistry Program Meeting, Warrenton, VA, June 9-12, 2002.
168. "QD-Bioconjugates Assembled Using Genetically Modified Proteins," S.-Y. Ding, M.E. Himmel, W.S. Adney, M.P. Tucker, J. Wall, J. Nedeljkovic, O.I. Micic, M. Jones, A.J. Nozik and G. Rumbles, To be presented at the MRS Symposium H: Bio-Inspired Nanoscale Hybrid Systems, San Francisco, CA, Spring 2003.
169. "Heterologous Expression, Purification, and Characterization of the Glycosyl Hydrolase Family 7 Cellobiohydrolases from *Trichoderma reesei* and *Penicillium funiculosum*," William S. Adney, Yat-Chen Chou, Stephen R. Decker, John O. Baker and Michael E. Himmel, To be presented as an oral paper at the 225th Annual American Chemical Society Meeting, New Orleans, LA, March 22-27, 2003.
170. "Molecular Mechanics Modeling of *Trichoderma reesei* Cel7A," T. Rignall, C. McCabe, D. Wood, J. Brady, and M. Himmel, To be presented at the Foundations of Molecular Modeling and Simulation (FOMMS) Annual meeting, Aspen, CO. July 6-11, 2003.
171. "Heterologous Expression, Purification, and Characterization of a Cellobiohydrolase from *Penicillium funiculosum*," Yat-Chen Chou, William S. Adney, Stephen R. Decker, John O. Baker and Michael E. Himmel, To be presented at the 25nd Symposium on Biotechnology for Fuels and Chemicals, Breckenridge, CO. May, 2003.
172. "The Effect of Lignin Modifying Enzymes on the Molecular Weight Distribution of kraft Lignin," Stephen R. Decker, Aarti Gidh, Michael E. Himmel, Todd B. Vinzant, To be presented at the 25nd Symposium on Biotechnology for Fuels and Chemicals, Breckenridge, CO. May, 2003.
173. "Increased Thermal Tolerance of *T. fusca* beta-Glucosidase via Directed Evolution," Eric E. Jarvis, William S. Adney, Stephen R. Decker, John O. Baker, Michael E. Himmel, To be presented at the 25nd Symposium on Biotechnology for Fuels and Chemicals, Breckenridge, CO. May, 2003.

NREL/DOE Patents & Related Activities

1. United States patent No. 5,110,735; entitled "Thermostable Purified Endoglucanase from Thermophilic Bacterium *Acidothermus cellulolyticus*", M.P. Tucker, K. Grohmann, A. Mohagheghi, and M.E. Himmel, May 5, 1992. Notice of allowance given for Japan (June, 1995).
2. United States Statutory Invention Registration No. H1149, entitled "High Solids Fermentation Reactor", C.E. Wyman, K. Grohmann, M.E. Himmel, and C.J. Rivard. March 2, 1993.
3. United States patent No. 5,275,944; entitled "Thermostable Purified Endoglucanase from *Acidothermus cellulolyticus*", M.E. Himmel, W.S. Adney, K. Grohmann, and M.P. Tucker, January 4, 1994.
4. International Application Publication No. WO93/15186 continued from US 5,275,944; entitled "Thermostable Purified Endoglucanase from *Acidothermus cellulolyticus*", M.E. Himmel, W.S. Adney, K. Grohmann, and M.P. Tucker.
5. World Patent (DE, GB, FR) entitled "Thermostable E1 Endoglucanase from *Acidothermus cellulolyticus*", M.E. Himmel, W.S. Adney, K. Grohmann, and M.P. Tucker. Filed October 27, 1993.
6. United States patent No. 5,366,884; entitled "Thermostable Purified Endoglucanase II from *Acidothermus cellulolyticus*", William S. Adney, Steven R. Thomas, Rafael A. Nieves, and Michael E. Himmel, November 22, 1994.
7. United States patent No. 5,432,075; entitled "A Low-Molecular Weight, Thermostable β -D-glucosidase from *Acidothermus cellulolyticus*", M.E. Himmel, M.P. Tucker, W.S. Adney, and R.A. Nieves, July 11, 1995.
8. International Application Publication No. WO94/29474; entitled "Treatment of Lignocellulose to Minimize Binding of Cellulase," N.D. Hinman, M.E. Himmel, and K. Grohmann.
9. International Application Publication No. WO94/29460; entitled "Active Heteroconjugates of Cellobiohydrolase and Beta-Glucosidase," J.O. Baker, M.E. Himmel, K. Grohmann, and S.R. Thomas.
10. United States Patent No. 5,536,655: "The Native Structural Gene Coding for the E1 endoglucanase from *Acidothermus cellulolyticus*," S. Thomas, R. Laymon, and M. Himmel. July 16, 1996. Filed in Europe, Australia, and Canada (12/12/96).
11. PCT publication of United States patent No. 5,432,075; entitled "A Low-Molecular Weight,

- Thermostable β -D-glucosidase from *Acidothermus cellulolyticus*", M.E. Himmel, M.P. Tucker, W.S. Adney, and R.A. Nieves (July 12, 1995).
12. PCT publication of United States patent 5,536,655: "The Native Structural Gene Coding for the EI endoglucanase from *Acidothermus cellulolyticus*," S. Thomas, R. Laymon, and M. Himmel (July 14, 1995).
 13. United States Patent No. 5,712,142 for NREL Invention Disclosure #95-56: "Method for Increasing Thermostability in Cellulase Enzymes," S.R. Thomas, W.S. Adney, J.O. Baker, Y.-C. Chou, and M.E. Himmel. Notice of allowance given 7/1/97. Filed Canada.
 14. NREL Invention Disclosure #95-56CIP: "The Cellulose Binding Domain Peptide from the EI Endoglucanase from *A. cellulolyticus*," S.R. Thomas, W.S. Adney, R.A. Laymon, and M.E. Himmel. U.S. Patent Pending, filed 2/25/97. First Office Action was 10/97. Filed Canada.
 15. NREL Invention Disclosure #93-21: *In planta* Expression of Cellulases for Biomass Conversion. RE-ACTIVATED and filed 4/98.
 16. Australian patent No. AU-B-30985/95: "Gene Coding for the EI Endoglucanase", S.R. Thomas, R.A. Laymon, and M.E. Himmel, 1/15/98.
 17. NREL Invention Disclosure #97-29: "A high Molecular Weight, Thermal Stable Endoglucanase III from *Acidothermus cellulolyticus*," R.A. Nieves, S.R. Decker, W.S. Adney, and Michael E. Himmel. Reported 9/97. Abandoned.
 18. NREL Invention Disclosure #97-28: "An Alkophilic and Protease Resistant Xylanase from A Hot Springs Fungus," Stephen R. Decker, William S. Adney, Todd B. Vinzant, and Michael E. Himmel. Reported 9/97. Abandoned 1/1/98.
 19. NREL Invention Disclosure #98-18: "Method for Increasing the Biomass-Degrading Activity of Endoglucanases", John O. Baker, William S. Adney, Yat-Chen Chou, Steven R. Thomas, and Michael E. Himmel. Reported 2/3/98. Submitted as Provisional 5/10/98. Abandoned.
 20. U.S. Patent # 6,013,860 D.J. Schaaf, S.R. Thomas, M.E. Himmel and D.M. Stalker, "Expression of Enzymes Involved in Cellulose Modification" 1/11/00. Filed 7/24/98 by Calgene, LLC (Serial No. 09/122,533).
 21. CIP filed 7/23/99 by Calgene, LLC (Serial No. 09/364,907): D.J. Schaaf, S.R. Thomas, M.E. Himmel and D.M. Stalker, "Expression of Enzymes Involved in Cellulose Modification".
 22. Foreign filing by Calgene, LLC (Serial No. US99/16579): D.J. Schaaf, S.R. Thomas, M.E. Himmel and D.M. Stalker, "Expression of Enzymes Involved in Cellulose Modification".

23. NREL Invention Disclosure #98-37: "An Alkophilic Dextranase I from *Streptococcus anulatus*," Stephen R. Decker, William S. Adney, Todd B. Vinzant, and Michael E. Himmel. Reported 5/98. Notice of allowance given 1/30/01.
24. NREL Invention Disclosure #98-45: "A Thermal Tolerant Exoglucanase from *A. cellulolyticus*." William S. Adney, Michael E. Himmel, Stephen R. Decker, and Todd B. Vinzant. Reported 6/98.
25. NREL Invention Disclosure #99-38: "Catalytically Enhanced Endoglucanase - Site 245", Michael E. Himmel, William S. Adney, John O. Baker, Joshua Sakon, Steven R. Thomas, and Todd B. Vinzant, Filed as Provisional US Patent 5/19/99.
26. NREL Invention Disclosure #99-45: "Reduced Glycosylation *Trichoderma reesei* CBH I", William S. Adney, Stephen R. Decker, Suzanne Lantz, John O. Baker, Todd B. Vinzant, Rafael A. Nieves, and Michael E. Himmel, Filed as Provisional US Patent 7/13/99.
27. NREL Invention Disclosure #99-38: "Catalytically Enhanced Endoglucanase - Site 245", Michael E. Himmel, William S. Adney, John O. Baker, Joshua Sakon, Steven R. Thomas, and Todd B. Vinzant, Filed as US Patent 5/19/00.
28. NREL Invention Disclosure #99-45: "Reduced Glycosylation *Trichoderma reesei* CBH I", William S. Adney, Stephen R. Decker, Suzanne Lantz, John O. Baker, Todd B. Vinzant, Rafael A. Nieves, and Michael E. Himmel, Filed as US Patent 7/13/00.
29. NREL Invention Disclosure #01-35: "A Thermal Tolerant Mannanase from *Acidothermus cellulolyticus*." Shi-You Ding, William S. Adney, Todd B. Vinzant, Michael E. Himmel. Filed 8/1/01.
30. NREL Invention Disclosure #01-37: "A Thermal Tolerant Multi-Domain Cellulase from *Acidothermus cellulolyticus*." Shi-You Ding, William S. Adney, Todd B. Vinzant, Michael E. Himmel. Filed 8/1/01.
31. NREL Invention Disclosure #01-36: "A Thermal Tolerant Avicelase from *Acidothermus cellulolyticus*." Shi-You Ding, William S. Adney, Todd B. Vinzant, Michael E. Himmel. Filed 8/1/01.
32. NREL Invention Disclosure #01-38: "A Thermal Tolerant Exoglucanase from *Acidothermus cellulolyticus*." William S. Adney, Shi-You Ding, Suzanne McCarter, Michael E. Himmel, Stephen R. Decker, and Todd B. Vinzant. Filed 8/1/01.

Organization/Support of Scientific Meetings

1. **Chaired Poster Session:** The 9th Symposium on Biotechnology for Fuels and Chemicals, Boulder, CO, May, 1987.
2. **Chaired Session:** "Bioprocessing Technology," J.R. Mattoon, co-chair, the Second Annual Colorado Biotechnology Symposium, Boulder, CO, September, 1989.
3. **Organized and Chaird International Symposium:** "Enzymes in Biomass Conversion," G. Leatham, co-chair, American Chemical Society (Cellulose, Paper, and Textile Div.), Boston, MA, June, 1990.
4. **Chaired Session:** "Bioprocessing Research," J.A. Doncheck, co-chair, the Thirteenth Symposium on Biotechnology for Fuels and Chemicals, Colorado Springs, CO, May, 1991.
5. **Organized and Chaird International Symposium:** "Biocatalyst Design for Stability and Specificity," G. Georgiou, co-chair, American Chemical Society (Biochemical Technology Division)/Fourth Chemical Congress Combined Meeting, New York, NY, August, 1991.
6. **Chaired Session at Symposium:** "Cellulase Biochemistry," the Cellulose '91 meeting organized by the American Chemical Society and Cellucon Conferences, New Orleans, LA, December, 1991.
7. **Organized and Chaird International Symposium:** "Bioconversion for Fuels", R. Overend, co-chair, the 1993 Annual American Chemical Society Meeting (Biotechnology Secretariat), Denver, CO, February, 1993.
8. **Organized and Chaird International Symposium:** "Applications of Industrial Biotechnology," S. Thomas, co-chair, the 1994 Annual Chemical Society Meeting (Biotechnology Secretariat and Cellulase, Paper, and Textile Division), San Diego, CA, March, 1994.
9. **Co-Chaired Session at Symposium:** "The symposium on Advances in the Bioconversion of Lignocellulosics," The 1994 Annual American Chemical Soc. Meeting, San Diego, CA, March, 1994.
10. **Co-Organized International Workshop:** "U.S. DOE - National Renewable Energy Laboratory sponsored workshop on Nomenclature of Cellulases and Other Related Enzymes," Lake Tahoe, CA, June, 1994.
11. **Organized Special Topics Sessions at International Symposium:** "The 17th Symposium on Biotechnology for Fuels and Chemicals, Vail, CO, May, 1995.
12. **Co-Chaired Session at International Symposium:** Session on "Applied Biotechnology" at the 19th Symposium on Biotechnology for Fuels and Chemicals, Colorado Springs, CO, May 4-8, 1997.
13. **Co-Chaired Session at International Symposium:** Session on "Enzyme Processes and Enzyme Production" at the 20th Symposium on Biotechnology for Fuels and Chemicals, Gatlinburg, TN, May 3-7, 1998.
14. **Organized and Chaird International Symposium:** "Glycosyl Hydrolases for Biomass Conversion," J. Saddler, co-chair, the 1999 Annual Chemical Society Meeting (Cellulase, Paper, and Textile Division), Anaheim, CA, March, 1999.
15. **Vice-Chair:** 2nd Annual Gordon Research Conference on "Cellulases and Cellulosomes," Procter, NH, July, 2001.
16. **Chair:** 3rd Annual Gordon Research Conference on "Cellulases and Cellulosomes" to be held in Procter, NH, July, 2003.

CURRICULUM VITAE - Brief

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PRESENT POSITION:

Senior Scientist II

- o Enzyme Technology Team Leader - supervise 6 to 8 staff scientists and postdocs doing biochemistry and cloning (19 yrs experience).
- o Adjunct Faculty: Department of Agricultural and Chemical Engineering at CSU, Fort Collins, CO.

EDUCATION:

- o PhD, Biochemistry, Colorado State University, Fort Collins, CO, December 1980
- o BS, Chemistry major and Biology minor, Magna Cum Laude, University of Northern Colorado, Greeley, Colorado, June 1974.

AWARDS:

- NREL/MRI 1993 Staff Award for Outstanding Personal Performance
- NREL/MRI 1997 Staff Award for Outstanding Team Performance

PROFESSIONAL ACTIVITIES:

- o Member, American Chemistry Society
- o Member, American Society of Microbiology
- o Member, Sigma Xi, Scientific Research Society
- o Member, Planning Committee, Symposium for Biotechnology of Fuels & Chemicals
- o Ad hoc Reviewer: *Appl. Biochem. Biotechnol.*, *J. Chromatogr.*, *Bioresource Technol.*, ACS Books, USDA SBIR, Consortium for Plant Biotechnology Research, DOE OS and DOE BES

PUBLICATIONS AND PATENTS:

Full length scientific papers: 132
Scientific posters and presentations: 160
Patents, PCTs, and DOE Invention Reports: 20

HOBBIES:

High plains archeology, photography, antique firearms, antique watches.

PERSONAL DATA: Health: Variable Marital Status: Married Age: 50